

(19)



(11)

EP 2 506 220 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
23.01.2019 Bulletin 2019/04

(51) Int Cl.:
G06T 19/00 ^(2011.01) **G01C 21/36** ^(2006.01)
G06F 3/0481 ^(2013.01)

(21) Application number: **12160278.3**

(22) Date of filing: **20.03.2012**

(54) **A display system**

Anzeigesystem

Système d'affichage

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GR
HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL
PT RO RS SE SI SK SM TR**

(30) Priority: **31.03.2011 GB 201105454**

(43) Date of publication of application:
03.10.2012 Bulletin 2012/40

(73) Proprietor: **SRT Marine System Solutions Limited
Midsomer Norton
Bath
BA3 4BS (GB)**

(72) Inventor: **Goralski, Rafal
Cardiff, South Glamorgan CF5 2SD (GB)**

(74) Representative: **Evans, Huw David Duncan et al
Chapman IP
Kings Park House
22 Kings Park Road
Southampton SO15 2AT (GB)**

(56) References cited:
**US-A- 5 583 972 US-A- 5 781 146
US-A1- 2003 210 832 US-A1- 2006 244 745
US-B1- 7 746 343**

EP 2 506 220 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to a display system and particularly, but not exclusively, to a display system for providing a visual representation of an environment.

[0002] When navigating a ship within a harbour, a submersible along a seabed or vehicle across a landscape for example, it is necessary to consult charts and maps to obtain information about the environment to ensure an efficient and safe manoeuvring. In this respect, it is necessary to combine information from various sources to establish an awareness of the environment.

[0003] Global positioning systems exist which enable a pilot of a ship or a operator of a vehicle for example, to determine their position relative to their surroundings, but such systems do not provide for an interactive representation of the environment so that the operator can obtain a visual representation and awareness of the landscape or bathymetry.

[0004] US2006/0244745 discloses a display system for providing a 3-dimensional visual representation of an environment in a display window of a display device together with a display reference marker representing a location within said representation of the environment, the displayed portion being selectable by a user by re-positioning the display reference marker within the generated representation of the environment, wherein a processor enables a user to selectively display said portion of the representation in the display window from one of a plurality of viewpoints from within the representation using a user interface, each viewpoint comprising the display reference marker at a fixed location within said window and within said representation.

[0005] US2003/210832 discloses a display system for providing a 3-dimensional visual representation of an environment, the system comprising a display device and a processor, the processor being arranged to:

receive information of the environment from at least one environment sensor;
generate a representation of the environment using the received information from said at least one environment sensor; and
output display signals representative of the received information to the display device, such that at least a portion of said generated representation of the environment is displayed in a display window of said display device,
wherein the processor enables a user to selectively display said portion of the representation in said display window from one of a plurality of viewpoints from within said representation using a user interface.

[0006] In accordance with the present invention there is provided a display system of the kind disclosed in US2003/210832, which is characterised in that said generated representation of the environment is displayed in

a display window of said display device together with a display reference marker representing a location within said representation of the environment, the displayed portion being selectable by a user by re-positioning the display reference marker within the generated representation of the environment, each viewpoint comprising the display reference marker at a fixed location within said window and within said representation, the processor enabling the user to selectively position said display reference marker within said representation using said user interface, the processor being arranged such that the portion of said generated representation of the environment displayed in the display window follows the topography/bathymetry of the representation of the environment as the user navigates the display reference marker within the representation.

[0007] Advantageously, the display system provides for an interactive virtual representation of an environment through the acquisition of information about the environment from environmental sensors, thereby enabling a user to navigate through the environment. Moreover, the system provides a situational awareness to the user by providing the user with various viewpoints of the environment.

[0008] The display reference is preferably alternatively or further selectable positioned at a specified location within said window by a user.

[0009] The display window is preferably rotatable with respect to the representation about an axis comprising the display reference, so that a user can steer the display direction, for example. Preferably, the axis further extends within a plane of the display window.

[0010] Preferably, a visual separation of the display window from the display reference within said representation is variable. This enables a user to obtain a magnified view of a particular location within the environment for example, or a more global view of the environment. The system thus combines different views, scales and perspectives of an environment, into a single cohesive view which allows for a quick and accurate manipulation and navigation, for example through the environment.

[0011] The display portion is preferably selectable by a user by re-positioning the display reference within the visual representation of the environment.

[0012] Preferably, the display system is further arranged to selectively display at least one group of environment features, such as marine buoys, buildings, hazardous areas, marine vessels, land vehicles and the like.

[0013] Preferably, the display system comprises a plurality of sensor modules, which are arranged to acquire information from the at least one environment sensor. The sensor modules comprise modules for sensing dynamic information of the environment, such as traffic, and modules for sensing static information of the environment, such as buildings.

[0014] Preferably, the system further comprises a user interface for enabling a user to input commands to the system.

[0015] The system further comprises optimisation modules for optimising the visual representation of the environment, in accordance with the information acquired from the sensor modules and user input commands.

[0016] The system preferably further comprises surveillance modules which are arranged to maintain real-time spatial relationships between objects within the representation and alert a user to potential dangers in the environment.

[0017] Preferably, the system further comprises an automated surveillance module which enables a passive surveillance of the environment without requiring any active input by the user. In this respect, the automated surveillance module is arranged to provide an automated navigation of a vehicle within an environment. If required however, a user may intervene upon observing the navigation and/or respond to system alerts for example.

[0018] The system preferably further comprises communication means for communicating sensor and/or surveillance information to remote locations. It is envisaged that this will enable remote operation of the system.

[0019] An embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawings in which

Figure 1 is a schematic illustration of a display system according to an embodiment of the present invention for displaying at least a portion of a representation of an environment; and,

Figure 2 is a schematic illustration of a display window of the display system illustrated in figure 1.

[0020] Referring to the drawings, there is illustrated a display system 10 for displaying a 3-dimensional visual representation of at least a portion of an environment 100, to an operator (not shown) of a vehicle (not shown). The system 10 may be disposed within a vehicle (not shown) and enables the operator of the vehicle, which may comprise a submersible (not shown), a ship 101 or a car 102, to suitably navigate a vehicle across a landscape 103a or upon a lake 103b by providing the operator with environment information in the form of a real-life, intuitive visual representation of the environment 100. It is also envisaged however, that the system 10 may be stationed remote to the vehicle being navigated, within a surveillance station (not shown) for example, and thus stationary with respect to the vehicle being navigated.

[0021] The system 10 comprises a plurality of sensor modules 11a, 11b which are arranged to acquire real-time information on dynamic environmental features, such as the movement of vehicles, sea conditions and the like, in addition to static environmental information such as topography and bathymetry. This information may be obtained from transponders 104, RADAR (Radio Direction And Ranging) stations 105, video streams from closed circuit television systems (not shown), SONAR (SOund Navigation And Ranging), LIDAR (Light Detec-

tion And Ranging) stations, and the like, in addition to existing charts and plots (not shown) of the environment 100. The sensor modules 11a, 11b are arranged to retrieve environmental information and output the sensed information to a processor 12, which subsequently processes the information and generates the visual representation on a display screen 13. The system 10 further comprises a user interface devices, such as a keyboard 14, a mouse 15, a joystick (not shown) and the like which enable an operator (not shown) to interact with the system 10 and provide operator commands and input to the system 10.

[0022] The processor 12 is further arranged to overlay a reference marker 16 upon the displayed representation so that an operator can select the area of the environment 100 to be displayed by suitably positioning the reference marker 16 at the desired location within the representation using an interface device, such as the mouse 15. The reference marker 16 may comprise a "dot" which may be disposed centrally of the display screen 13 or at any other operator specified location within to the display screen 13.

[0023] The marker 16 provides a reference for the operator in selecting the displayed direction relative to the operator (not shown). The displayed direction may be an absolute direction, for example a relocation of the marker at a specified location within the representation to provide an operator with a representation of the selected location. Alternatively, the marker 16 may serve to provide a relative direction, for example a view of the selected location from a different viewpoint from within the representation and in this case, the marker 16 is arranged to remain at a fixed position, namely locked, within the display screen 13, for each viewpoint.

[0024] In the case of a change in absolute direction, the display 13 will provide an apparent motion to the operator as the operator slides the marker 16 across the representation of the environment 100, as illustrated by arrows B in figure 2 of the drawings. In this case, the system 10 is arranged to operate in one of two modes. In the first mode, the marker 16 is arranged to remain at a selected altitude above or below sea level, as long as the terrain/bathymetry permits, whereas in the second mode, the marker 16 is arranged to remain at a selected altitude above the terrain/bathymetry, and is arranged to follow the contour of the terrain to maintain this altitude as the marker 16 moves across the terrain.

[0025] In the case of a change in the relative direction, the marker 16 is arranged to remain at a fixed location within the representation and provides a reference about which the display 13 can pivot to provide a view of the location from all positions around the location. For example, upon positioning the marker upon the hull of a ship 101, then the display system 10 can provide a view from all around the ship 101 from below the hull to above the hull, and thus enable a ship pilot for example, to determine whether there is sufficient water depth to manoeuvre within a harbour (not shown). This change in relative

direction is achieved by combining a change in viewing altitude with respect to the representation, as illustrated with arrow C-C, with a rotation of the displayed view about a vertical and/or horizontal axis 17a, 17b which extend within the display screen 13 and which extend through the marker 16 (as illustrated in figure 2 of the drawings).

[0026] In addition, the operator (not shown) can adjust the apparent separation of the display 13 from the marked location (as indicated by arrow A-A) to reduce the separation to obtain a magnified view of the location, and thus obtain a detailed representation of the location, as indicated by the display portion 13a. Alternatively, the operator may increase the apparent separation to obtain a more global view of the location, as indicated by the display portion 13b.

[0027] The system further comprises an optimisation module 18 for optimising the visual representation of the environment 100 in dependence of the sensed information and operator input commands, for example the operator specified viewing direction. For example, the optimisation module 18 may be arranged to restrict the rotation of the viewing direction about the horizontal axis 17b in accordance with the apparent separation of the display screen 13 from the location, to prevent the viewing direction falling from below the terrain surface. As a further example, the optimisation module may be arranged to increase the apparent size of environmental objects as an operator zooms out from a location within the representation, so that the objects remain visible to the operator. This may be further supplemented with a change in the colour of displayed objects, for example.

[0028] The system 10 further comprises a surveillance module 19 for providing real-time information on the separation of the objects, such as obstacles and vehicles, within the environment 100 to alert the operator to potential collision hazards, for example. Similarly, the system 10 further comprises an automated surveillance module which allows for an automated navigation and operation of a vehicle (not shown) within the surveyed environment 100 without the need for any active input from the operator. If required, the system 10 may communicate the information from the sensor and surveillance modules 11, 19, 20, using a communication device 21, to enable a remote operation of the vehicle.

[0029] In order to provide more intuitive representation of the visual representation of the environment, the system is further arranged to selectively populate the display with a plurality of groups of environmental objects, such as marine buoys, and vehicles (not shown) proximate to the vehicle (not shown) being manoeuvred.

[0030] From the foregoing therefore, it is evident that the display system provides for an improved manoeuvrability and navigation of vehicles, through the provision of an intuitive visual representation of the environment.

Claims

1. A display system (10) for providing a 3-dimensional visual representation of an environment (100), the system comprising a display device (15) and a processor (12), the processor (12) being arranged to:

receive information of the environment (100) from at least one environment (100) sensor; generate a representation of the environment (100) using the received information from said at least one environment (100) sensor; and output display signals representative of the received information to the display device (15), such that at least a portion of said generated representation of the environment (100) is displayed in a display window of said display device (15),

wherein the processor (12) enables a user to selectively display said portion of the representation in said display window from one of a plurality of viewpoints from within said representation using a user interface (15), **characterised in that** said generated representation of the environment (100) is displayed in a display window of said display device (15) together with a display reference marker (16) representing a location within said representation of the environment (100), the displayed portion being selectable by a user by re-positioning the display reference marker (16) within the generated representation of the environment (100), each viewpoint comprising the display reference marker (16) at a fixed location within said window and within said representation, the processor (12) enabling the user to selectively position said display reference marker (16) within said representation using said user interface (15), the processor (12) being arranged such that the portion of said generated representation of the environment (100) displayed in the display window follows the topography/bathymetry of the representation of the environment (100) as the user navigates the display reference marker (16) within the representation.

2. A display system (10) according to claim 1, wherein the processor (12) enables the user to selectively position said display reference marker (16) within said window using said user interface (15).
3. A display system (10) according to claim 1 or 2, wherein the display window is rotatable with respect to the representation about an axis comprising the display reference marker (16), so that the user can steer the display direction.
4. A display system (10) according to any preceding

claim, wherein a visual separation of the display window from the display reference marker (16) within said representation is variable.

5. A display system (10) according to any preceding claim, wherein the display system (10) is arranged or further arranged to selectively display at least one group of environment (100) features. 5
6. A display system (10) according to any preceding claim, further comprising a plurality of sensor modules, which are arranged to acquire information from the at least one environment (100) sensor. 10
7. A display system (10) according to claim 6, further comprising optimisation modules for optimising the visual representation of the environment (100), in accordance with the information acquired from the sensor modules and user input commands. 15
8. A display system (10) according to any preceding claim, further comprising surveillance modules which are arranged to maintain real-time spatial relationships between objects within the representation and alert the user to potential dangers in the environment (100). 20
9. A display system (10) according to any preceding claim, further comprising an automated surveillance module which enables a passive surveillance of the environment (100) without requiring any active input by the user. 25
10. A display system (10) according to claims 6 and 8, further comprising communication means for communicating sensor and/or surveillance information to remote locations. 30

Patentansprüche

1. Ein Anzeigesystem (10) zur Bereitstellung einer dreidimensionalen visuellen Darstellung einer Umgebung (100), wobei das System eine Anzeigevorrichtung (15) und eine Verarbeitungseinheit (12) umfasst, wobei die Verarbeitungseinheit (12) so angeordnet ist, dass: 40
 - sie Informationen zu der Umgebung (100) von mindestens einem Sensor der Umgebung (100) empfängt; 45
 - sie mittels der von dem genannten mindestens einen Sensor der Umgebung (100) empfangenen Informationen eine Darstellung der Umgebung (100) erzeugt; und 50
 - sie die empfangenen Informationen darstellende Anzeigesignale an die Anzeigevorrichtung (15) ausgibt, sodass zumindest ein Abschnitt 55

der genannten erzeugten Darstellung der Umgebung (100) in einem Anzeigefenster der genannten Anzeigevorrichtung (15) angezeigt wird,

wobei es die Verarbeitungseinheit (12) einem Benutzer ermöglicht, den genannten Abschnitt der Darstellung mittels einer Benutzerschnittstelle (15) selektiv aus einem aus einer Vielzahl von Blickpunkten innerhalb der genannten Darstellung in dem genannten Anzeigefenster anzuzeigen, **dadurch gekennzeichnet, dass** die genannte erzeugte Darstellung der Umgebung (100) zusammen mit einer eine Position innerhalb der genannten Darstellung der Umgebung (100) darstellenden Anzeigereferenzmarkierung (16) in einem Anzeigefenster der genannten Anzeigevorrichtung (15) angezeigt wird, wobei der angezeigte Abschnitt durch einen Benutzer auswählbar ist, indem die Anzeigereferenzmarkierung (16) innerhalb der erzeugten Darstellung der Umgebung (100) neu positioniert wird, wobei jeder Blickpunkt die Anzeigereferenzmarkierung (16) an einer festen Position innerhalb des genannten Fensters und innerhalb der genannten Darstellung umfasst, wobei es die Verarbeitungseinheit (12) dem Benutzer ermöglicht, die genannte Anzeigereferenzmarkierung (16) mittels der genannten Benutzerschnittstelle (15) innerhalb der genannten Darstellung selektiv zu positionieren, wobei die Verarbeitungseinheit (12) so angeordnet ist, dass der in dem Anzeigefenster angezeigte Abschnitt der genannten erzeugten Darstellung der Umgebung (100) der Topografie/Bathymetrie der Darstellung der Umgebung (100) folgt, wenn der Benutzer die Anzeigereferenzmarkierung (16) innerhalb der Darstellung bewegt.

2. Ein Anzeigesystem (10) nach Anspruch 1, wobei es die Verarbeitungseinheit (12) dem Benutzer ermöglicht, die genannte Anzeigereferenzmarkierung (16) selektiv innerhalb des genannten Fensters mittels der genannten Benutzerschnittstelle (15) zu positionieren. 40
3. Ein Anzeigesystem (10) nach Anspruch 1 oder 2, wobei das Anzeigefenster in Bezug auf die Darstellung um eine Achse umfassend die Anzeigereferenzmarkierung (16) drehbar ist, sodass der Benutzer die Anzeigerichtung steuern kann. 45
4. Ein Anzeigesystem (10) nach einem vorhergehenden Anspruch, wobei eine visuelle Trennung des Anzeigefensters von der Anzeigereferenzmarkierung (16) innerhalb der genannten Darstellung veränderbar ist. 50
5. Ein Anzeigesystem (10) nach einem vorhergehenden

den Anspruch, wobei das Anzeigesystem (10) so angeordnet ist oder weiter so angeordnet ist, dass es selektiv mindestens eine Gruppe von Merkmalen der Umgebung (100) anzeigt.

6. Ein Anzeigesystem (10) nach einem vorhergehenden Anspruch, weiter umfassend eine Vielzahl von Sensormodulen, die so angeordnet sind, dass sie Informationen von dem mindestens einen Sensor der Umgebung (100) erfassen.
7. Ein Anzeigesystem (10) nach Anspruch 6, weiter umfassend Optimierungsmodule zur Optimierung der visuellen Darstellung der Umgebung (100) entsprechend den Informationen, die über die Sensormodule und Benutzereingabebefehle erfasst wurden.
8. Ein Anzeigesystem (10) nach einem vorhergehenden Anspruch, weiter umfassend Überwachungsmodule, die so angeordnet sind, dass sie räumliche Echtzeit-Beziehungen zwischen Objekten innerhalb der Darstellung beibehalten und den Benutzer vor potenziellen Gefahren in der Umgebung (100) warnen.
9. Ein Anzeigesystem (10) nach einem vorhergehenden Anspruch, weiter umfassend ein automatisiertes Überwachungsmodul, das eine passive Überwachung der Umgebung (100) ohne eine erforderliche aktive Eingabe durch den Benutzer ermöglicht.
10. Ein Anzeigesystem (10) nach Anspruch 6 und 8, weiter umfassend Kommunikationsmittel zur Kommunikation von Sensor- und/oder Überwachungsinformationen an entfernte Positionen.

Revendications

1. Un système d'affichage (10) destiné à la fourniture d'une représentation visuelle tridimensionnelle d'un environnement (100), le système comprenant un dispositif d'affichage (15) et un processeur (12), le processeur (12) étant agencé de façon à :
 - recevoir des informations relatives à l'environnement (100) à partir d'au moins un capteur d'environnement (100),
 - générer une représentation de l'environnement (100) au moyen des informations reçues à partir dudit au moins un capteur d'environnement (100), et
 - produire en sortie des signaux d'affichage représentatifs des informations reçues vers le dispositif d'affichage (15), de sorte qu'au moins une partie de ladite représentation générée de l'environnement (100) soit affichée dans une fenê-

tre d'affichage dudit dispositif d'affichage (15), où le processeur (12) permet à un utilisateur d'afficher de manière sélective ladite partie de la représentation dans ladite fenêtre d'affichage à partir d'un point de vue d'une pluralité de points de vue à partir de l'intérieur de ladite représentation au moyen d'une interface utilisateur (15), **caractérisé en ce que** ladite représentation générée de l'environnement (100) est affichée dans une fenêtre d'affichage dudit dispositif d'affichage (15) conjointement avec un marqueur de référence d'affichage (16) représentant un emplacement à l'intérieur de ladite représentation de l'environnement (100), la partie affichée étant sélectionnable par un utilisateur par le repositionnement du marqueur de référence d'affichage (16) à l'intérieur de la représentation générée de l'environnement (100), chaque point de vue comprenant le marqueur de référence d'affichage (16) à un emplacement fixe à l'intérieur de ladite fenêtre et à l'intérieur de ladite représentation, le processeur (12) permettant à l'utilisateur de positionner de manière sélective ledit marqueur de référence d'affichage (16) à l'intérieur de ladite représentation au moyen de ladite interface utilisateur (15), le processeur (12) étant agencé de sorte que la partie de ladite représentation générée de l'environnement (100) affichée dans la fenêtre d'affichage suive la topographie/bathymétrie de la représentation de l'environnement (100) à mesure que l'utilisateur fait circuler le marqueur de référence d'affichage (16) à l'intérieur de la représentation.

2. Un système d'affichage (10) selon la Revendication 1, où le processeur (12) permet à l'utilisateur de positionner de manière sélective ledit marqueur de référence d'affichage (16) à l'intérieur de ladite fenêtre au moyen de ladite interface utilisateur (15).
3. Un système d'affichage (10) selon la Revendication 1 ou 2, où la fenêtre d'affichage est pivotable par rapport à la représentation autour d'un axe comprenant le marqueur de référence d'affichage (16), de sorte que l'utilisateur puisse orienter la direction d'affichage.
4. Un système d'affichage (10) selon l'une quelconque des Revendications précédentes, où une séparation visuelle de la fenêtre d'affichage à partir du marqueur de référence d'affichage (16) à l'intérieur de ladite représentation est variable.
5. Un système d'affichage (10) selon l'une quelconque des Revendications précédentes, où le système d'affichage (10) est agencé ou agencé en outre de façon à afficher de manière sélective au moins un groupe de caractéristiques d'environnement (100).

6. Un système d'affichage (10) selon l'une quelconque des Revendications précédentes, comprenant en outre une pluralité de modules de capteur, qui sont agencés de façon à acquérir des informations à partir du au moins un capteur d'environnement (100). 5
7. Un système d'affichage (10) selon la Revendication 6, comprenant en outre des modules d'optimisation destinés à l'optimisation de la représentation visuelle de l'environnement (100), conformément aux informations acquises à partir des modules de capteur et de commandes en entrée d'utilisateur. 10
8. Un système d'affichage (10) selon l'une quelconque des Revendications précédentes, comprenant en outre des modules de surveillance qui sont agencés de façon à maintenir des relations spatiales en temps réel entre des objets à l'intérieur de la représentation et à alerter l'utilisateur de dangers potentiels dans l'environnement (100). 15 20
9. Un système d'affichage (10) selon l'une quelconque des Revendications précédentes, comprenant en outre un module de surveillance automatisé qui permet une surveillance passive de l'environnement (100) sans exiger une entrée active quelconque par l'utilisateur. 25
10. Un système d'affichage (10) selon les Revendications 6 et 8, comprenant en outre un moyen de communication destiné à la communication d'informations de capteur et/ou de surveillance vers des emplacements distants. 30

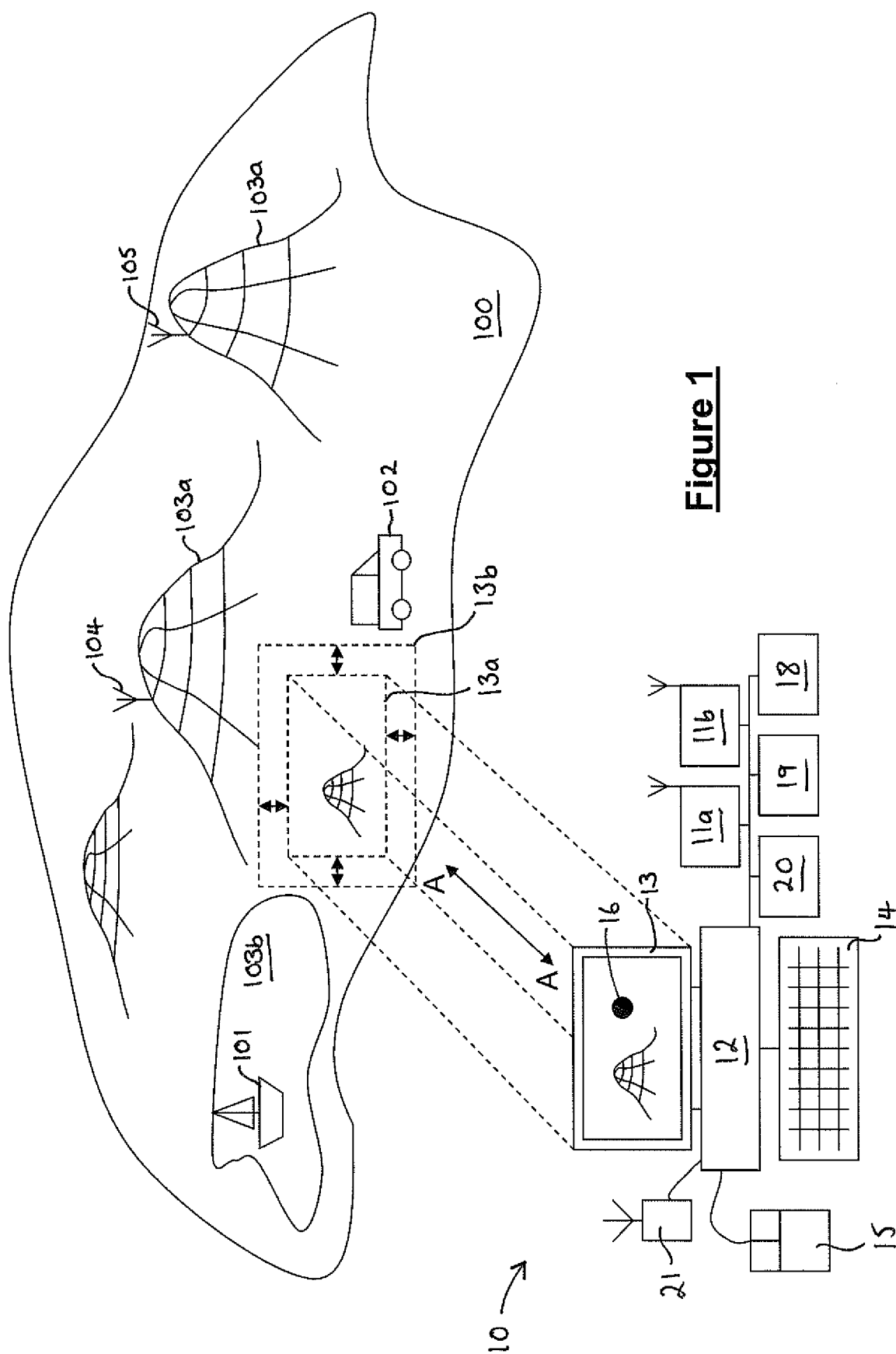
35

40

45

50

55



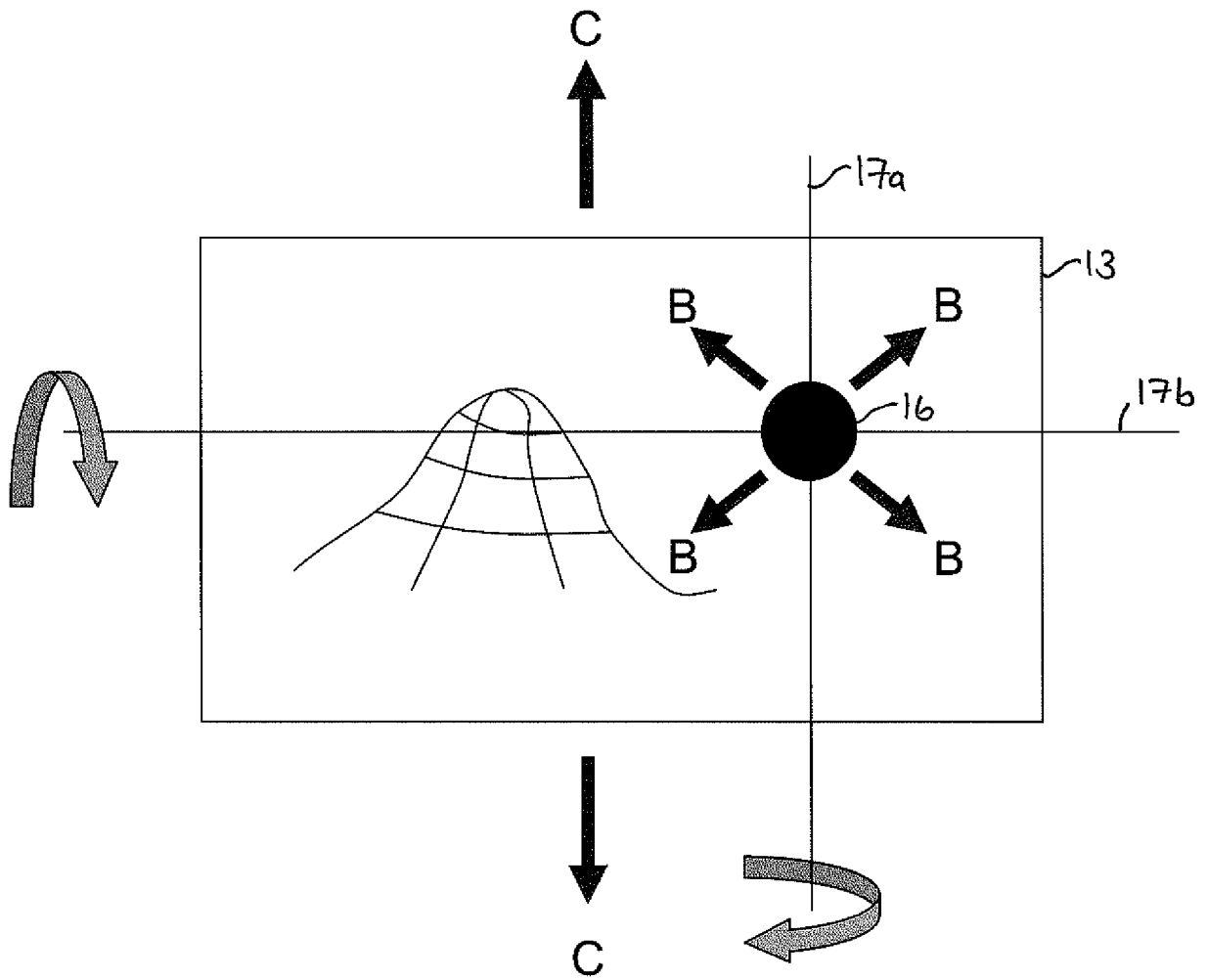


Figure 2

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20060244745 A [0004]
- US 2003210832 A [0005] [0006]